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What Factors Determine the Production of Independent Smallholder Oil Palm?

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Abstract. Oil palm is the most efficient crop in producing oil than other crops, such as soybean, rapeseed, and sunflower. However, the oil palm plantation of independent smallholders faced low productivity in terms of input used. This study aims to determine the production factors that influence independent oil palm smallholders in Kumpeh Sub-district, Muaro Jambi District. This research was conducted in three villages in Kumpeh, namely Mekarsari, Betung, and Seponjen. Samples consisted of 63 smallholders and were taken using the Simple Random Sampling method. The data were analyzed descriptively and subjected to statistical tests of multiple linear regression analysis. The results show an R2 of 0.888, indicating that the model variables can explain 88.8% of the oil palm production variation. The F test resulted in a value of 115.299, showing that the production variables together have a real effect on production. Partially, the independent variables that have a real and significant impact on oil palm production at a realistic level (α) of 5% are land area, fertilizer, and pesticides. At the same time, labor does not significantly affect palm oil production.

Keywords: independent smallholders, oil palm, production factor

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1. Introduction

Palm oil has been the most significant agricultural export in Indonesia. The annual export value of Indonesian palm oil is more than USD 18 billion [1]. Palm oil is a valuable source of foreign exchange and significantly contributed to the origins of biodiesel's national target (B-30) by 2020. Oil palm cultivation is also a labor-intensive source of income for more than 4.5 million people who work in the oil palm plantation. The number of employees will be more than double,

Oil palm is the prime commodity cultivated in the Jambi Province. It is the main livelihood of many of its locals, especially in the Kumpeh Sub-district, Muaro Jambi District. The palm oil commodity in Kumpeh is currently in the productive age, yielding high production. The plants

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range from 7-15 years old; no replanting is needed as there are no plants that are categorized as old.

The majority of oil palm plantations in Kumpeh is managed independently. Independent smallholders typically apply traditional management methods and do not utilize the right cultivation technology in their operations. Furthermore, the absence of farmer groups for plantation crops, especially for oil palm in Kumpeh, denies smallholders from receiving information on the proper oil palm cultivation methods, namely seeding, care, pest and disease control, fertilizing, and harvesting from plantation crop instructors. Therefore, cultivation is only done through the experience without following procedures that are following the recommendations. It shows the lack of knowledge of oil palm smallholders on useful oil palm cultivation techniques. During the past five years, the productivity of oil palm in Kumpeh tends to decrease each year. As it was commonly known, smallholder farmers are mostly own limited capital and looking for cheaper and lower quality inputs and have limited access to palm oil mill that made them receive less price [4].

Through a long and risky process, we get an agricultural product. The time required depends on the commodity. Not only time but the sufficiency of production factors also contribute to production. Production factors are absolute, and it can be improved by fulfilling sufficiency requirements, providing optimal palm oil production.

From 2013 to 2017, plantation areas in Kempe have increased each year [5]. This data shows that production should have increased, but in reality, it has not. Therefore, the locals need to know the factors that affect production to provide optimal production increases. This study analyzes the factors that influence the production of independent palm oil smallholders in Kumpeh Sub-district, Muaro Jambi District.

2. Methods

The data used in this study consist of primary and secondary data. Primary data were obtained by direct observation and interviews from independent palm oil smallholders. Secondary data is data obtained from various related literature. Data collection methods consist of surveys, observations, and interviews as primary data (questionnaire). Sampling is done using the simple random sampling method, which chooses several randomly selected samples. The total sample is 63 people. Statistical inference is used for data analysis. Production factors include land area, labor, fertilizers, and pesticides. The inferential study is conducted throughout the multiple linear regression analysis. It can be formulated as follows:

$$Y = F(X1, X2, X3, X4) \quad (1)$$

where: Y: Palm oil producstion (kilograms/year); X1: Land area (hectares); X2: Labor use

(WD/year); X3: Fertilizer use (kilograms/year); X4: Pesticide use (liters/year)

Before the model is in the run. The models used must meet the classic assumption tests, including multicolineritas assumptions, heteroscedasticity, autocorrelation, and normality. If these assumptions are fulfilled, they will result in a good guessing variable. Suppose there is otherwise one assumption in the multiple regression model that the obtained function cannot fulfill. In that case, the correctness of model guessing or hypothesis testing for decision-making is still in doubt.

3. Results and Discussion

3.1. Description of Oil Palm Plantations

Many farmers depend on palm oil products for their livelihoods, oil palm cultivation has become the main livelihood of some locals in Kumpeh. Many farmers also cultivate other commodities such as rice and corn to increase income.

Oil palm trees in Kumpeh are currently in their productive age. Therefore, production can fulfill household needs if the smallholders treat the tree according to recommendations. However, many smallholders' economic condition prevents them from doing so, resulting in less optimal conditions.

The absence of institutional support for oil palm cultivation in Kumpeh has caused difficulties for the locals in improving production. Furthermore, the lack of smallholder groups prevents the locals from receiving innovations commonly obtained through agricultural instructors. Extension services are crucial for farmers, especially those that seek innovation.

The production factors in oil palm cultivation are land, capital, and labor, which are most effective when all three are fulfilled. Production factors in Kumpeh are as follows:

a. Land area

Land area is the area or place used for farming activities on a parcel of land measured in hectares. According to [6], the greater the size of cultivated land, the higher the production and income per unit of area. The distribution of land in Kumpeh in Table 1.

Table 1. Land Distribution of Sample Farmers in Kumpeh Sub-district, Muaro Jambi District in 2019

No	Land Area (Ha)	Frequency	Percentage (%)
1	1 – 1,99	3	4,76
2	2 – 2,99	30	47,62
3	3 – 3,99	9	14,29
4	4 – 4,99	13	20,63
5	5 - 5,99	6	9,52
6	6 – 6,99	2	3,17
Amount		**63**	**100**

Table 1 shows that the average land area in Kumpeh is more than 2 hectares, considerable. [7] classified farmers based on their land area: (1) large, with more than 2 ha of land, (2) medium, with 0.5-2 ha of land, (3) small, with less than 0.5 ha of land, and (4) landless farmers.

b. Labor

Labor is an important factor in oil palm farming activities; it can determine said activities' success. Workers used in oil palm farming are family workers (FW) and non-family workers (NFW). The distribution of labor in the study area, as seen in Table 2.

Table 2. Distribution of Labor in Kumpeh Sub-district, Muaro Jambi District, 2018 – 2019

No	Activities	Average Working Days (WD)/Year			Average WD/Ha/Year		
		WD Non-Family	WD Family	Total WD	WD Non-Family	WD Family	Total WD
1	Pruning	4.08	11.36	15.44	0.92	4.22	5,14
2	Fertilization	5.85	14.69	19.57	1.17	5.85	7,02
3	Maintenance	3.44	8.93	12.37	0.70	2.94	3,64
4	Harvesting	28.73	51.81	80.54	9.48	19.61	29,09
Amount		**42,10**	**86.79**	**128.89**	**12.27**	**32.62**	**44.89**
Percentage		**32,66**	**67.34**	**100**	**27.33**	**72.67**	**100**

Based on the table above, family workers dominate the labor distribution in Kumpeh with a percentage of 67.34, while non-family workers make up the remaining 32.6%.

c. Fertilizer

Fertilization provides a significant contribution to increasing the production and quality of palm oil. Local smallholders utilize several types of chemical fertilizers, including NPK, dolomite, KCL, and TSP. The distribution of fertilizer use can be seen in Table 3 below.

Table 3. Distribution of Fertilizer Application in Kumpeh Sub-district, Muaro Jambi District, 2018 – 2019

No	Fertilizer Application	Frequency/Year		
		Average (kg/year)	Average(kg/ha/year)	Average/plant(kg/year)
1	NPK	1042.48	380.44	2,75
2	Dolomit	791.67	285.56	0,81
3	KCL	364.40	132.47	0,96
4	TSP	201.70	47.84	0,34

Based on the table above, NPK is the most used fertilizer with 380.44 kg/ha/year. This condition is because of its complete nutrients that are needed by oil palm plants. Meanwhile, TSP is the least applied fertilizer, with a usage of only 47.84 kg/ha/year. It is far from the recommended dosage use of pesticides.

Pesticides are used in oil palm farming activities to prevent the growth of weeds. There are two types of pesticides used, namely gramaxon and round up. Table 4 describes the pesticide usage.

Table 4. Distribution of Pesticide Application in Kumpeh Sub-District Muaro Jambi District, 2018 - 2019

No	Pesticide Application (L/year)	Frequency	Percentage (%)
1	1 – 6	5	7.94
2	7 – 12	22	34.92
3	13 – 18	11	17.46
4	19 – 24	9	14.29
5	25 – 30	4	6.35
6	31 – 36	9	14.29
7	37 – 42	2	3.17
8	43 – 48	1	1.59
	Total	**63**	**100**
	Average (liter/Year)		**18,62**

Based on the table above, oil palm in the study area uses an average of 18.62 liters/year of pesticides. Pesticide spraying is directly proportional to the severity of weeds, 2-3 times were spraying a year, depending on the condition.

3.2. Determination of Independent Oil Palm Smallholder Production

Agricultural products are obtained through a long and risky process. The time required is dependant on the commodity. According to [8], production can only occur if requirements are met, namely production factors. It consists of four components, namely land, capital, labor, and skills or management. Each factor has a different function and is related to each other. If any of the factors are not available, production will not occur [9]. The success of oil palm farming is supported by the continuous availability of agricultural raw materials in the right amount. It is influenced by various production factors, which must be considered as they significantly affect production. Multiple linear regression analyzes the factors that affect palm oil production because the model has more than one independent variable. The results can be seen in Table 5.

Based on Table 5, the following equation of the regression model for the palm oil production function model in Kumpeh is obtained:

$$Y = (9{,}332) + 0{,}567 \ln X_1 - 0{,}025 \ln X_2 + 0{,}010 \ln X_3 + 0{,}419 \ln X_4 \quad (2)$$

The F test is used to determine whether the study's independent variables simultaneously influence the dependent variable, namely oil palm production. The confidence level used is 0.05. Results show that if the sig value is equal to 0,000 < α (0.05), then reject H0, accept H1. This means a simultaneous influence between independent variables, namely land area, labor, fertilizer, and pesticides, on the dependent variable: the production of oil palm.

Table 5. Result of Multiple Regression Analysis on Factors Affecting Oil Palm Farming Production*

Coefficients						
	Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	9.332	0.381		24.525	0.000
	Land Area	0.567	0.091	0.486	6.206	0.000
	Labor	-0.025	0.107	-0.021	-0.234	0.816
	Fertilizer	0.010	0.005	0.099	2.092	0.041
	Pesticide	0.419	0.057	0.540	7.337	0.000
	R-squared		0.888	F_{stat}	115.299	
	Adjusted R-squared		0.881	Sig	0.000	

Significant on level of 95%
*the data in per hectare

In this study, the determination coefficient or R^2 is 0.888 or 88.8%. This shows that the land area, labor, fertilizer, and pesticide variables can explain the dependent variable (production) by 88.8%. In comparison, the remaining 11.2% is explained by other variables outside of these four. Independent variables that significantly affect palm oil production are land area, fertilizer, and pesticides, while labor does not. The results of the regression equation can be described as follows:

a. Effects of Land area (X1) towards palm oil production in Kumpeh Sub-district, Muaro Jambi District

The results of the land area variable (X1) analysis shows a sig value of 0,000 > α = 0.05, which means rejecting H0 and accepting H1. This means that land area significantly affects oil palm production. X1 has a regression coefficient of b1 = 0.567. It showed a positive estimation, which means that one unit's increase in the land area will increase production by 0.567%. This is in line with the research conducted by [10], which shows that each additional land area of one unit will increase production. Therefore, it can be concluded that the land area is directly proportional to production.

b. Effects of Labor (X2) towards palm oil production in Kumpeh Sub-district, Muaro Jambi District

The labor variable (X2) analysis results show a sig value of 0,816 > α = 0,05, which means rejecting H0 and accepting H1. It means that labor does not affect oil palm production. X2 has a regression coefficient of b2 is –0,025. It showed a negative estimation, which means that one unit's increase in labor will decrease production by 0.025%. It is in line with the research conducted by Pangaribuan, B. (2013), which shows that partially, labor inputs will contribute negatively and decrease production. An increase in labor by one unit will decrease production by 0.14%.

c. Effects of Fertilizer (X3) towards palm oil production in Kumpeh Sub-district, Muaro Jambi District

The fertilizer variable (X3) has a regression coefficient of b3 = 0,010. It means that each increase in fertilizer by one unit will increase production by 0.010%. The X3 analysis results show a sig value of 0,041 < α = 0,05, which means rejecting H0 and accepting H1. It means that fertilizer significantly affects oil palm production. It is in line with the research conducted by [10], which shows that each additional fertilizer of one unit will also increase production by one unit. Therefore, fertilizer is directly proportional to production.

d. Effects of Pesticides (X4) towards palm oil production in Kumpeh Sub-district, Muaro Jambi District

The pesticide variable (X4) has a regression coefficient b4 = 0,419. This means each increase in pesticides by one unit will increase production by 0.419%. The X4 analysis results show a sig value of 0,000 < α = 0,05, which means rejecting H0 and accepting H1. This means that pesticides significantly affect oil palm production. It is in line with the research conducted by [11], which shows that each additional pesticide of one unit will also increase production by one unit. Therefore, it can be concluded that pesticides are directly proportional to production.

4. Conclusion and Recommendation

The affect of Production factors, namely land area, labor, fertilizer, pesticides, into palm oil production in Kumpeh Sub-district can be explained by the model with a value of 0.888%, variables outside the model explain the remaining 11.2%. Production factors with real and significant effects on palm oil production are land area, fertilizer, and pesticides, while labor does not.

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